



Executive Summary

Enterprise IT organizations that align themselves with their enterprise’s overall goals help the organization increase and enhance its business agility, shareholder value, customer experience as well as fully integrate security throughout the IT strategy. The cloud is widely viewed as an effective vehicle for achieving these goals. It pools resources, virtualizes and distributes network services, completely automates operations, centralizes orchestration, and fully integrates security. There is little consensus, however, on the best transition strategy to move from fabric-based data center switching infrastructure to a private cloud solution.

Juniper Networks’ open data center network architecture is designed to seamlessly transform existing data center infrastructure into an elastic, agile cloud infrastructure, and protect the original investment in physical gear and the accumulated operational experience. The architecture is built upon open networking standards and open interfaces in the system architecture that fully protect the existing switching equipment investment.

ACG Research analyzed the transition costs from state-of-the-art switching infrastructure to elastic and agile infrastructure that enables private enterprise cloud for a medium-sized enterprise data center. The Juniper Networks’ open data center infrastructure architecture was compared to a proprietary programmable architecture that requires simultaneous investment in a centralized controller and application-aware switch combination. The proprietary architecture requires parallel operation of the existing switching equipment and the new application-aware switches until all applications are moved to the new switches. This is a multiple-year effort for most enterprises. In contrast, the open architecture does not require any change in the existing infrastructure base. The study found that the open architecture provides full asset protection; the proprietary architecture destroys 88 percent of the value of the original switching investment in the first year of the transition period.

KEY FINDINGS

The transition cost of moving the fabric-based switching equipment of a medium-sized data center to an enterprise private cloud design is analyzed for Juniper Networks’ open data center architecture versus proprietary programmable network architecture.

- Juniper Networks’ open architecture seamlessly works with existing environments through use of a control plane overlay and open standards
- Proprietary programmable architecture requires simultaneous investment in a controller and new switching equipment
- Proprietary architecture destroys 88% of the value of the existing investment in the first year

Introduction

There is a broad consensus on the business and functional end-state for enterprise IT: IT must shift from a service organization to a strategic organization aligned with the overall goals of the enterprise. Specifically, IT leadership should look for solutions that will help the enterprise:

- Increase business agility
- Increase its value and return on investment
- Enhance customers' experiences
- Fully integrate security throughout the strategy

There also is a strong consensus that an enterprise cloud is the best way to accomplish these business objectives and what the cloud end-state should look like:

- Resources are pooled
- Network services are virtualized and distributed
- Operations are fully automated
- Orchestration is centralized
- Security is fully integrated throughout the cloud

There is no consensus, however, on how to transition the IT organization and the existing IT infrastructure to a strategic IT organization and cloud end-state. Open issues include:

- Though it is clear that software-defined networking (SDN) will be part of the solution, what SDN solutions make sense? Hardware-specific SDN? Software-specific SDN? Device-based SDN? Is SDN mature enough? How will SDN affect legacy systems?
- What form should orchestration take? Should it be open source or commercial? Who will control it? What roles will applications, servers, and the network play? Is a new breed of cloud needed?
- What security intelligence strategy is needed to protect the enterprise in real time? How are physical and virtual security handled and what should the priorities be? Where throughout the infrastructure should security policies be enforced?
- What protocols will become dominant? How can the adoption and ratification activities of standards bodies be incorporated into the transition strategy?
- How should a big data strategy be incorporated into the transition? How should data overload be transformed into actionable knowledge and insight?
- What processes and organizational forms should be adopted to support the end-state infrastructure? What training is needed? What staff roles and skills are required? What types of transition teams are needed?

The data center infrastructure costs to make the transition to the enterprise private cloud are examined for two application-aware networking architectures:

1. Juniper Networks' open data center architecture
2. A proprietary programmable networking architecture that requires investment in a centralized controller and application-aware switch combination

Juniper's Cloud Transition Strategy

Juniper's view is that an open architecture provides an enterprise the flexibility to adapt its data center infrastructure to most effectively resolve the open transition issues and thus protect the enterprise's infrastructure investment. Juniper's cloud transition strategy is guided by two principles: 1) offer a choice of best-of-breed solutions (this explicitly avoids a single vendor lock-in), and 2) pursue an evolutionary and nondisruptive path without forklift upgrades.

The cloud transition strategy seeks to accelerate innovation and business agility by emphasizing:

- **Adaptability:** Maintain a choice of best-of-breed solutions and protect the original investment to the existing network environment. This is accomplished by supporting open standards and supporting programmability across silicon, systems, and software.
- **Seamless scale:** Capacity can be efficiently scaled both upward and downward without adding complexity. Juniper's innovation in IP and switching fabrics enables adding scale and maintaining logical simplification (seamless scale). SDN deployments scale out using a distributed SDN architecture and leveraging federated SDN controllers, which maintain logical simplification and protect the existing investment. Security also is scaled out across physical appliances and virtual services by applying similar principles.
- **Intelligence:** Provide information flows from the switches themselves. This enables correlation analysis and real-time analytics to correlate the physical and virtual network data that are used to implement context-aware networking. This awareness enables proactive optimization of IT resources and real-time security assurance by keeping track of new threats and malware that could impact the business environment.

Data Center Infrastructure Transition Cost Analysis

The cost to move from a fabric-based switching network to the enterprise private cloud infrastructure is compared for the two architectural alternatives. Cost is modeled for a medium-sized data center that is characterized by:

- 12 racks
- 40 servers per rack
- 576 10GE ports
- 25 applications to be migrated to enterprise private cloud

Open Data Center Infrastructure Architecture

The open architecture for transition to enterprise private cloud is designed to seamlessly migrate existing infrastructure to the cloud as it protects the investment in physical gear and the accumulated operational experience. Juniper Networks MetaFabric is an open data center architecture that accelerates enterprises' transition to private and hybrid clouds through the deployment and delivery of applications within and across multiple data centers. This open architecture is delivered through a combination of powerful switching, routing, and security platforms that leverage feature-rich silicon, programmable systems, network orchestration, SDN, and open APIs, which enable integration with the technology ecosystem. As part of this open architecture, Contrail SDN solution sits on top of the open data center infrastructure and enables the transition to SDN. It consists of two software modules: the Contrail Controller and Contrail vRouter.

The Contrail Controller sits between the orchestration system and network devices and communicates via open RESTful APIs. The Contrail vRouter handles control plane and forwarding plane functions

running on a hypervisor. The Controller integrates with open cloud orchestration solutions (for example, OpenStack, Cloudstack) and service providers’ OSS/BSS systems. Three key functions are delivered:

1. Configuration: accepts a request from an orchestrator (for example, OpenStack) for provisioning a virtual machine (VM) and assigns a network to the VM. It converts this high-level request into a low-level request that can be understood by existing network elements.
2. Control: interacts with the network elements using the standard XMPP protocol and directs the provisioning of the network for a VM. It maintains network state by interacting with its peers using industry-standard BGP to ensure network resiliency and uptime.
3. Analytics: collects, stores, correlates, and analyzes information across network elements. This information can be consumed by the end user or network applications through Contrail’s northbound REST API.

The ability of Contrail to integrate with open as well as commercial cloud orchestration solutions provides a choice of best-of-breed cloud orchestration solutions. Use of industry-standard BGP protects the investment in existing data center switches, and the use of REST APIs supports a choice of best-of-breed analytics solutions.

Proprietary Programmable Architecture

This architecture employs a controller that is the unifying point of automation and management for the switching fabric. The controller provides centralized access to all fabric information, optimizes the application lifecycle for scale and performance, and supports flexible application provisioning across physical and virtual resources. Unlike the open data center infrastructure architecture, the controller uses a proprietary protocol and information model to communicate with agents in the southbound switches with which it is working. The switches use onboard custom software agents and custom-designed forwarding hardware to translate the messages into enhanced data plane and traffic processing functions (such as policy-based forwarding for specific application classes or custom data collection to support network analytics under the guidance of the controller). As such, deployment of the controller requires a simultaneous investment in the application-aware switching infrastructure. There will be a period of time, consequently, when this new switching infrastructure must operate side by side with the existing switching equipment because enterprises migrate applications sequentially from the existing infrastructure to a parallel greenfield environment.

Analysis of Transition Costs

It is assumed that existing data center networking infrastructure includes switches that were installed during the last several years in two steps for each alternative as shown in Table 1.

Step	Open Architecture	Proprietary Programmable
I	Virtual Chassis	Legacy Ethernet Switch
II	Fabric Switch	Fabric Switch

Table 1 – Installed Base of Data Center Switches

Each alternative switching solution has similar functionality. The architectural approaches to making the transition to enterprise private cloud, however, are quite different. No additional investment in data center networking infrastructure is needed to make the transition. In contrast, the proprietary

programmable alternative requires a forklift upgrade to the switching infrastructure because its controller is intrinsically linked to a new and proprietary fabric switching system. Figure 1 summarizes the investment required to establish the existing infrastructure and the incremental total cost of ownership (TCO) to make the architectures ready for enterprise private cloud.

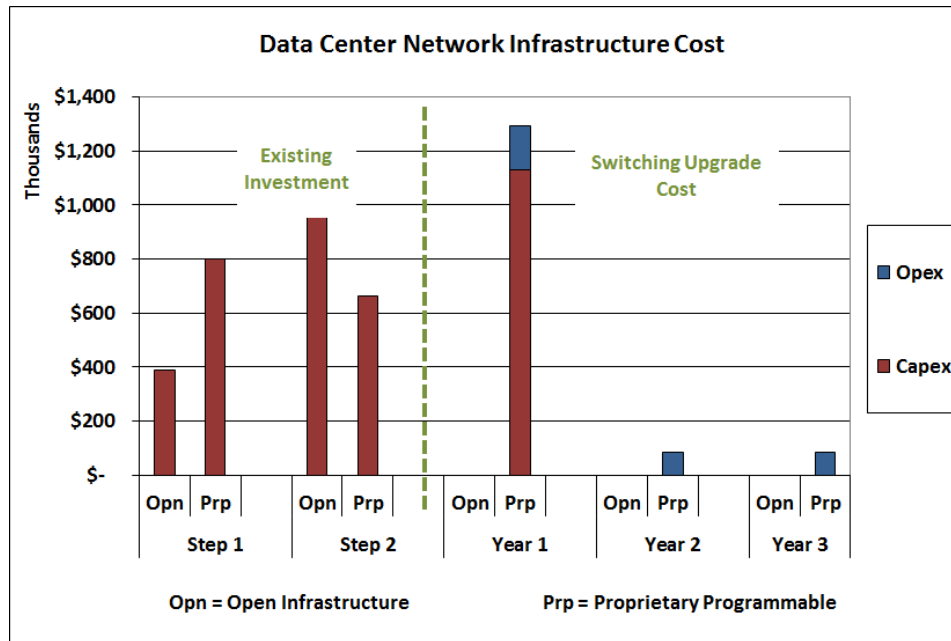


Figure 1 – Data Center Network Infrastructure Cost

Whereas the open infrastructure requires no additional cost to be ready for private cloud the proprietary programmable architecture requires a large additional investment to move to private cloud.

Figure 2 shows the cumulative cost to transition to enterprise private cloud infrastructure for the open architecture and proprietary programmable architectures.

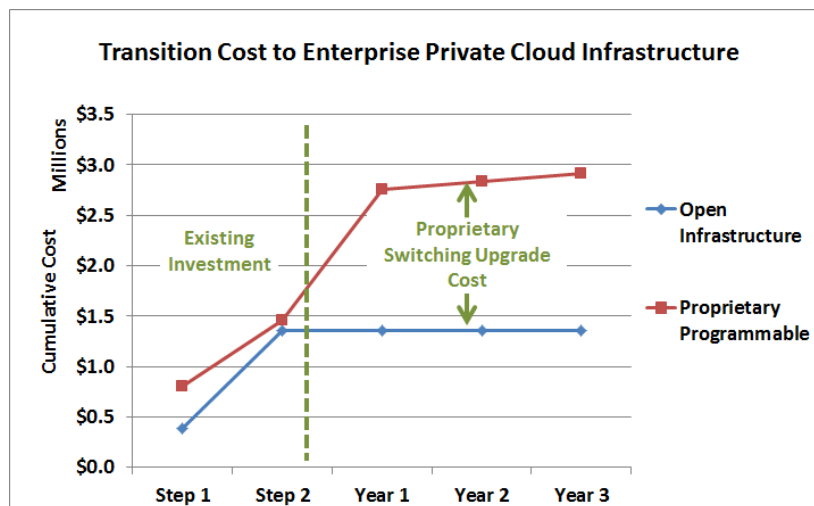


Figure 2 – Transition Cost Analysis

The cumulative investment in existing data center infrastructure (See Table 1 for details) is shown to the left of the dashed line in Figure 2. The functional capabilities of the underlay infrastructures are similar

in that they both provide state-of-the-art virtualized switching fabrics and nearly equal cumulative investment cost through the end of Step 2.

The cost on the right of the dashed line in Figure 2 shows the cumulative costs incurred through Step 2 plus the incremental total cost of ownership for making the data center infrastructure ready for enterprise private cloud¹. The open infrastructure alternative has no additional TCO because the Contrail SDN solution is implemented as an overlay to the open infrastructure²; as a result the open architecture is cloud-ready right after Step 2 without requiring any additional cost. In contrast, in Year 1 of the transition to private cloud the proprietary programmable architecture has incremental TCO equal to 88 percent of the installed cost of the existing switching equipment; most of the initial asset value is destroyed.

The transition cost of the proprietary programmable alternative also includes incremental operation expense (opex) costs because the new fabric switching systems do not replace the existing switching equipment until all 25 applications have been moved from the original environment. This is a multiyear transition. Table 2 tabulates the cost of the additional operation expenses (opex) required by the proprietary programmable alternative.

Opex Item	One-Time Charge	Annual Amount
Engineering, Facilities, and Installation	\$56,424	
Testing and Certification Operations	\$8,464	
Training	\$15,700	
Floor Space Cost		\$13,333
Power Cost		\$9,752
Cooling Cost		\$15,603
Service Contracts		\$43,566
Total	\$80,588	\$82,254

Table 2 – Incremental Opex for Proprietary Programmable Alternative

The open architecture approach has no incremental opex, because no change is required to the existing switching equipment to make the transition to enterprise private cloud.

Conclusion

There is a broad consensus that enterprise IT must shift from a service organization to one aligned with the enterprise’s overall goals to help the enterprise increase business agility, increase its value, enhance customers’ experiences, and fully integrate security throughout the IT strategy. There also is a consensus that enterprise cloud is the best way to achieve these goals. The cloud will pool resources,

¹ The controller license fee is excluded from the cost analysis.

² Key standards compliant requirements include support for BGP, XMPP, NetConf, MPLSprotocols and integration with leading commercial (for example, IBM and VMWare) and open source (for example, OpenStack and CloudStack) cloud orchestration solutions.

virtualize and distribute network services, fully automate operations, centralize orchestration, and completely integrate security throughout the cloud.

There are, however, many issues remaining on how best to make the transition from fabric-based data center switching infrastructure to the enterprise private cloud. Two architectural alternatives are:

1. Juniper Networks' open data center infrastructure architecture
2. A proprietary programmable architecture that requires investment in a centralized controller and application-aware switch combination

The transition cost for each architectural alternative was analyzed for a medium-sized data center. The open data center infrastructure architecture fully protects the existing switching investment by employing the Contrail SDN controller that operates as an abstracted overlay to the open switching infrastructure underlay; it has no transition cost. In contrast the proprietary programmable architecture requires that simultaneous investment be made in a centralized system controller and application-aware switch combination. This deployment of a new proprietary system controller and new data center switching equipment has a first-year TCO equivalent to 88 percent of the existing switching equipment investment. As such most of the value of the original equipment base is destroyed.

As transition to private cloud accelerates, more enterprises are feeling the pressure to future-proof their investment in cloud networking, cloud orchestration, and automation platforms. Selection of public or other clouds to seamlessly integrate and federate with Juniper's open data center infrastructure technology is proven to empower a smooth data center transition to private cloud and provide the best investment protection as compared to proprietary programmable approaches in the industry.

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